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TEACHING TOPOGRAPHICAL ORIENTATION AND SPATIAL ORIENTATION TO CONGENITALLY BLIND CHILDREN

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Five years ago Miss Ascarelli began a longitudinal study of the spatial organization of congenitally blind children with the anticipation that a sequential order of development would be observed. The difficulty encountered in obtaining a valid measure of performance on many tasks because of the marked inability of many of the blind children to explore their environment gave rise to the study reported in this issue of the *Journal of Education.*

With the assistance of a grant under the Cooperative Research Program of the U. S. Office of Education and with the cooperation of Dr. Edward J. Waterhouse, Superintendent of the Perkins School for the Blind in Watertown, Mass., an experiment in teaching topographical orientation and object perception to a group of totally blind children between the ages of 6 and 15 was carried out during 1958 and 1959.

THE AUTHORS

The director of the study, Dr. Ralph Garry, has been a member of the Boston University faculty for ten years. He is co-author of the text *Nature and Conditions of Learning* published by Prentice-Hall. Readers of the *Journal* will recall previous monographs on *Television for Children,* and *Character Education: Methods and Materials,* which grew out of his work as project director for the Foundation for Character Education of Boston.

Miss Ascarelli, now a Research Associate at Boston University, has taken degrees at Syracuse and Harvard Universities, with special reference to the educational, psychological, and social problems of handicapped children. During her more than six years' work with multiple handicapped children at the Perkins School, she developed the training methods reported here. She is currently engaged in similar research with pre-school blind children.

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Teaching Topographical Orientation and Spatial Orientation to Congenitally Blind Children

Ralph J. Garry Anna Ascarelli

CONTENTS

PROBLEM 3
HYPOTHESES AND OBJECTIVES 4
PROCEDURE 5
TRAINING PROGRAM 6
MEANING AND DEVELOPMENT OF SPATIAL ORGANIZATION . . 8
Orientation 8
Object Perception 12
Language 19
METHOD OF TEACHING 22
Phase one: Posture, position and fluidity of movements . . 23
Phase two: Structuring extended space 24
Phase three: Perception of objects 26
Phase four: Language 29
Lesson plans 34
THE SPATIAL RELATIONS PERFORMANCE TEST 40
DATA GATHERED AND RESULTS 44

TABLES

TABLE 1. Chronological and Mental Ages of Control and Experimental Groups 45
TABLE 2. Pre- and Post-test Scores of Control and Experimental Groups 47
TABLE 3. Differences between Pre- and Post- tests of Control and Experimental Groups and Net Difference between Groups 48

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PROBLEM

Retrolental fibroplasia has greatly increased the number of blind children of school age. This condition, which was first recognized in 1937 at the University of Chicago Clinics, is usually, although not exclusively, associated with prematurity — that is, with a birth weight of five pounds or less — and is known to be the effect of an excessive concentration of oxygen in incubators.

In a large percentage of cases retrolental fibroplasia results in total blindnss which, taking into consideration the concomitant fact of prematurity, may be regarded as congenital, though in reality it did not exist at the time the baby was born. This group of congenitally totally blind children presents to parents and educators problems of greater complexity than children who have some residual vision or who have lost their sight later in life. At first a high incidence of mental retardation was suspected in this group of children who seemed to develop slower than expected, often exhibited a large number of mannerisms, and had difficulty keeping up educationally with their age group. It is tragic that many parents were told that their children were mentally retarded, as a more careful interpretaion of the meaning of prematurity and a closer study of the mental ability of these children later disproved the diagnosis. This indicates, however, that the meaning of total blindness is still little known. This research represents an attempt to gain a better understanding of the problems of congenitally totally blind children and to test the possibility of meeting these problems with an especially designed training program.

Direct observations, interviews with teachers and school personnel in constant contact with children, and more objective data obtained through the administration of a Spatial Relation Performance Test to a group of about seventy totally blind children between the ages of 5 and 15 furnished the evidence that about fifty per cent of this group, regardless of chronological age or intelligence quotient, had difficulties which centered around the understanding and application of spatial concepts and resulted in poor orientation, lack of manipulative skills, and limited interest in the environment. It was also found that there were some perceptual and behavioral patterns that appeared frequently in this group at all age levels observed. It was possible then to formulate the broad outline of a program of training in spatial organization. A group of 30 children was selected and subdivided in 5 age groups to make possible further study of the development of spatial organization with age and eventually to evaluate results of training and adaptability of specific activities at the various levels.

The selection of the method of this research was based upon the following assumptions:

1. Perception is a conscious activity originating with the awareness of an environment of experience and ending in cognition.
2. Perception of self, orientation, object perception, and language are essential aspects of spatial organization.
3. It is possible to isolate patterns of spatial behavior which become characteristic of a child early in life and tend to endure.
4. Some of these patterns are perceptually more efficient than others.
5. A training program offers the possibility of continued observations on a group of children at various stages of development.

HYPOTHESES AND OBJECTIVES

1. It is possible, through group training, to direct or change the direction of the development of spatial perceptual patterns.
2. It is possible to develop a program of training in spatial organization, such that it may be used with children between 5 and 15 years of age by introducing variations in the order of presentation of lessons, the objectives and materials remaining basically unchanged.
3. The administration of such a training program may help our understanding of the meaning of total blindness and of spatial organization and of the relative importance of the various aspects of spatial organization to topographical orientation and perceptual learning.
4. It may be possible to evaluate the role of tactual and motor skills in the development of perceptual patterns, and to indicate specific teaching techniques.
5. This study may furnish criteria for the evaluation of commonly used didactic materials and for the selection of others.
6. This study may furnish data on the desirability of making available to preschool and school age children training in spatial organization as a developmental or remedial program.

PROCEDURE

Sample: The total sample included 70 congenitally totally blind children, between the ages of 5 and 14, inclusive, regularly enrolled at the Perkins School for the Blind, Watertown, Massachusetts, and without evidence of additional physical handicap. Of this total sample 60 children were selected for the present study.

Controls: On the basis of testing and observations on the development of spatial perception done by these investigators at the time this study was planned, it was felt that the congenitally blind children could be divided into two groups. (1) Those children whose inability to explore or investigate environmental stimuli inhibits their spatial development; and (2) Those children who are more or less adequate in exploration. In all instances the first group shows inadequate "attack" procedures and restricted spatial development as determined by test, and observation reports by teachers and cottage supervisors. These deficiencies do not appear to be associated with mental age, chronological age or sex. In this study group #1 was selected for special training. Group #2 (whose "attack" procedures are more or less adequate and spatial development apparently "normal") was not to receive training. Chronological age, sex, mental age were controlled by crude matching of the groups, but the essential controls were of two kinds: (1) Each child in the training group was to serve as his own control — improvement in spatial performance as judged by changes in pre- and post-testing, and by pre- and post-ratings by teachers and cottage supervisor on spatial orientation. (2) Comparison of performance between the two groups.

Experimental design: Sixty congenitally totally blind children between 5 and 14 were given a Spatial Relation Performance Test. Cottage supervisors' and teachers' ratings on the orientation and space perception of these children were obtained. On the bases of these ratings and test scores the total group was divided into two groups of good performers and poor performers, and the groups were roughly matched by chronological age. For the purpose of training, the poor-performer group was further divided into five groups of six children each and training was initiated with that phase of the program that seemed best suited to meet the specific common difficulty of the group. Unfortunately, it was not possible to select the groups on the basis of individual difficulties because of scheduling availability. Each group received a half-hour training daily for twelve weeks during the spring of 1958. The program was resumed in October, 1958 and carried out till May, 1959. During this second year, each group met twice a week for one hour periods. Three children of the original experimental group had left school and were not replaced. The same number of children, of corresponding age, was dropped from the control group. Upon termination of the training program, post-tests were administered to experimental and control groups, and new ratings were obtained from cottage supervisors and teachers. During the months of December and May of the second year each child was individually observed by a person not otherwise connected with this study, and rated on those aspects of behavior that seemed relevant to this research. The inquiry was intended to learn if the training program produced significant differences on an independent test of spatial relations, and if it produced transfer of training to spatial development and spatial orientation.

TRAINING PROGRAM

The following aspects of space organization were selected: perception of self, orientation, object perception, and language: accordingly the phases of the training program centered around awareness of postural changes, concept and manipulation of extended surfaces, concept of three dimensional space, and meaningfulness of spatial vocabulary. For each phase, lessons were devoted to isolate specific experiences that would help children to gain an awareness of the genesis of the various perceptual aspects and of their contextual meaning. A brief outline of the phases of the training program will be given in terms of the concepts and skills each one purposed to test and develop while a description of the meaning and development of the aspects of spatial organization will serve as the theoretical orientation and justification of the related phases of the training program. It is necessary, however, to point out that both the spatial organization and the program were thought of as wholes and that the divisions mentioned were dictated by the experimental nature of this study and used here for clarity of exposition. In practice, the carrying out of the program required considerable overlapping of the various phases and integration of activities.

Phase one: Specifically concerned with teaching ways in which posture and body movement help in the determination of position of self and in establishing a point of reference for the location of other places, objects, or persons, and the importance of fluidity of movement in goal directed activity.

Phase two: A variety of approaches to the problem of structuring extended space, proceeding from surface to direction, perimeter and shape, encouraging comparison of temporal and spatial sequences and the formation of spatial patterns, the symbolic reduction of which is represented by topology. Space of locomotion was related to brachial space with reference to extension, direction, and shape. Specifically, the following relationships were stressed: position of the body and postural shifts, locomotion and direction of movement, termination of one directional movement and position, position and direction to localization and shape. Special attention was given to ways in which sounds structure space, by their nature giving information about the presence of particular objects and identifying places, and by their qualities indicating directions, openings, obstacles, and distances. The identification of the source of contemporary sounds creates acoustic shapes by fusing direction and distance. These first two phases broadly correspond to those aspects of spatial organization that constitute orientation, both as organized body space and topographical representation.

Phase three: Specifically concerned with three dimensional space and the perception of objects. Starting with the identification of the position of lines and planes as absolute and relative to other lines and planes, building concepts of straightness, horizontality, perpendicularity, parallelism, etc., then proceeding to the exploration of objects showing how these concepts are used to arrive at the cognition of form and structure. Emphasis was placed on the modality of touch, on tactual illusions, and on specific motor and sensory skills. Perceptual characteristics were analyzed in terms of their relevancy to the identification of objects, stressing the fact that the temporal order in which they are uncovered or the motor sequence representing them do not correspond to the value they have in terms of the form structure and meaning of the object. Reduction of motor-tactual sensations to spatial representations, and abstractive synthesis were encouraged by stressing the intention to form images and by schematic two- and three-dimensional reproductions.

Phase four: The main purpose of this phase was to show how the organization of space may be expressed and communicated symbolically, through gestures, postural attitudes, sounds, designs, plastic representations, mimicry, and language. Careful attention was given to the relationship of language to experience, stressing the need for accuracy and specificity of description for the clear understanding of the meaning of words and of their symbolic value.

MEANING AND DEVELOPMENT OF SPATIAL ORGANIZATION

Orientation

DEFINITIONS:

Orientation is a process by which directions are ascertained and the position of the self, buildings and other objects localized in terms of the points of the compass or some other general reference. Thus defined orientation implies the concepts of position, localization, direction and distance. In the experience of the blind child orientation originates with awareness of body position as static, of postural changes as they accompany movement, and of the motor-muscular sensations of locomotion. The formation of concepts of locations, direction and distance is based on the conscious translation of these bodily feelings into spatial atemporal relationships through the progressive reduction of the subjective involvement and the creation of a world of objects, the position of which signifies the structure of that space that the experience of movement posits as empty space. The meaning of this reduction will become clearer as we proceed to analyze these concepts and attempt to trace the genesis and development of their motor and perceptual elements.

Position: The concept of position combines in an abstractive synthesis the perception of the body as a whole, that is, of the body as a limited physical object, capable of assuming, maintaining, and changing posture, and the perception of the posture of the body in relation to one or more points of reference outside of the body, such as floor, walls, etc. Position thus refers to the orientation of the body at each moment with reference to its axis and to one or more other planes. In this sense the most common positions are vertical and horizontal, implying relationships of parallel and perpendicular.

Location: The concept of location is not based on postural perceptions but views the position of the body in relation to the position of other objects in a spatial continuum, usually represented by an extended continuous surface. The concept of location requires the ability to imagine the position of self and of other objects as existing and enduring.

Direction: Direction is the ordering of locations according to a general rule, such as the compass points. This concept of direction is quite remote from actual experience, especially that of the blind child who can perceive only one location at a time — his own — and this by referring his position to that of another object within his brachial space.

Distance: Linear space between locations. In experience, distance is movement through time.

PERCEPTUAL ASPECTS OF ORIENTATION:

Through tactual activity a baby experiences his body as an object. As sensations become more specific and as he learns to localize them and to control movements, he becomes aware of the limits of his body and of his belonging to it. From then on the body is the subject of the experience of a reality that unfolds as an increasing range and specificity of sensations. The child is the object of his own experiencing physicality till he becomes aware of being a self other than his body and consciously assumes his body as a mode of appearance in the world and consciousness as his subjectivity. He can now objectify reality

as it emerges at each new physical encounter of his body with something other than itself and translate the sensory impact of experience in perceptual relationships of meaning.

The body: Posture, position, and location. The ability to maintain awareness of the self as separate from the body is basic to all aspects of the spatial organization of the blind child since he experiences his environment tactually and motorially, and the physical world as such ceases to exist altogether the moment his tactual-motor activity ceases, unless he can spatialize his sensations. Translation of tactual-motor sensations in perceptual-spatial representations requires the understanding of the spatiality of the body and of the meaning of movement referred to it as to a spatial object, that is, externalized and indifferent to body sensations. Orientation, as well as object perception, is based upon awareness of body position — which is awareness of the spatial relationships of parts of the body to its axes, and of the body as a whole to other bodies. When completely abstracted from postural and motor feelings, and conceived as objectively enduring, position comes to signify location.

Motion and locomotion: Extension, direction, and distance. The development of the understanding of the spatial dimensions of the body leads to the understanding of position and location as the place actually or imaginatively occupied by the body and other objects. Awareness of the body qua spatial object, when related to locomotion, makes possible the understanding of extensionality, direction, and distance. It is possible to attempt a description of the development of these understandings which, without pretending to be exact, still may be useful in suggesting activities and method of teaching.

The experience of creeping may be important to the development of orientation and spacial organization, as it affords the child a perception of self as the center of a bounded space which, because of his position, he can completely appropriate. Provided sufficient and repeated stimulation to locomotion and a limited and constant environment, creeping may represent the experience of the continuity of a level surface, of the endurance of locations, and of the solidity of barriers. It is possible, however, that the blind child does not perceive the floor as such because of the homogeneity and internality of his tactual-motor experience of it while creeping. He may perceive the boundaries of this creeping space as something other than himself because they represent the sudden imposition of a barrier to locomotion. The same barriers, as the child learns to stand up and begins to walk, may become assimilated within the body limits of the child as he uses them for support, frontally bracing them with both hands and pulling towards himself.

Moving from place to place the blind child is first of all aware of his own movements. The first vague meaning that "direction" acquires is derived from the awareness of postural changes as shown by the fact that blind children often explain the meaning of the word "direction" by referring to the sensations experienced in a car making a sudden or sharp turn — and this may be unfortunate because what is experienced is a gravitational pull in the direction opposite to the turn of the car. An association of right and left turn with this sensation, which is quite likely to occur, is not a serviceable one for the child at this stage, in fact, it may be a faulty one in terms of the meaning of "right" and "left". A sensation somewhat similar is that experienced in rapid twirling the body but here again, if the association of right and left is extended, it refers to a direction of motion or postural shift and not locomotion. Many blind children do not seem spontaneously to notice changes in direction while walking

or being led or guided by someone, perhaps because these changes are too gradual to result in definite sensations, or perhaps because often a child led by the hand is not walking frontally but somewhat sideways and turns actually are experienced as variations in acceleration or deceleration. Gait and rhythm obviously play a part in determining the quality and quantity of perceptual discriminations possible.

When the child learns to turn right and left as different from gyrating and to evaluate the degree of the rotation needed — which is difficult in the absence of visual feed-back — direction acquires the meaning of a difference in body orientation but still refers to a movement at a fixed location. When right and left turns are followed by, and consciously referred to, locomotion direction is projected in space and becomes direction of movement, and at the same time movement is recognized as change in location.

The next problem is that of maintaining the direction of movement, and here the blind child has to cope with the complications presented by spontaneous veering. Veering, of course, is not peculiar to the blind child, but in the absence of the continuous correction that vision normally provides, the veering of the blind results in a directional error, the magnitude of which is a function of the strength of the tendency to veer, the distance, the time employed in covering the distance, the balance of the child, and, naturally, the nature of the terrain. The time element could be termed rate of walking more properly than speed. Regardless of the degree of veering, the child does not appear to be aware of the actual magnitude of the resulting error. Sidedness may influence veering and remain a motor constant so closely integrated with the experience of walking that it cannot be spontaneously isolated. When the child is being led and the veer is controlled, the observable result is often a noticeable pattern of body weight shift, or a difference in the length of the steps (right and left) or in the force (stamping) of the steps. To some extent the feeling of the upright is influenced by the same factors. Though it may be assumed that the factors influencing veering are constants, many blind children learn to use auditory cues to correct it, and many others can be taught to control veering or to correct the error. Only in the case of control of veering it is possible to speak of direction of motion, however, the intentionality of direction operating in this case is the same as that allowing a correction of a veer error. In terms of the relationship of direction to distance and location, to control veer, depending on how habitual it is, may be equivalent to no veer while to correct the error results in a changed relationship by introducing an intermediate location that must be recognized as such, and therefore intentionally discarded, qua location, while being provisionally retained as body position. Veer error correction should become automatic before direction can become a step towards orientation. In this case the error position would not represent an intermediate location — in fact it would not be differentiated from any other moment of the temporal-kinesthetic experience, nor would the latter have to be emphasized during the beginning stage of the process of orientation, which, for its completion, requires the negation of this very experience.

So far two meanings of the word direction have been considered, namely: positional orientation of the body, and direction of movement of the body. These two meanings are directly experienced by the child who can move freely, as they are based on motor-kinesthetic sensations and on the appreciation of the extent of the space of movement. At this stage, the child has achieved a level of orientation which may be termed subjective. He is capable of orienting himself with regard to a source of sound: he can turn towards it and walk to

it, provided he can localize it accurately. He may also be capable of memorizing his way from one place to another by the use of auditory and temporal-muscular cues. This does not represent topographical orientation which is the ordering of locations according to an objective rule, as previously defined. To achieve topographical orientation the child must learn to interpret his sensations in terms of space, of objects, and of enduring locations. Here, direction acquires a third meaning: the relative orientation of two or more locations. Before this meaning may be realized, the child must understand location as movement from and towards a location or, in other words, view his activity as space between locations, or distance in a determined direction. As far as his concept of space is concerned it must change from space of movement — and therefore empty space — to space as container of objects, characterized by extent, direction, and distance. His concept initially acquired with reference to body position must extend to include a multiplicity of objective relationships. In the absence of sight there is no direct experience of this container space or of location in itself: they can only be understood through a process of perceptual abstraction by which motor-kinetic sensations are spatialized and objectified. It is possible for a blind child to form a mental image of the spatial relations existing between locations, provided sufficient experience coupled with a conscious intent towards spatial synthesis.

At the same time sounds and smells acquire a distinctiveness and specificity that develops in sign and symbol meanings and schema. Sound is now known to be the source of obstacle perception. Direction of sound, echoes, resonances, differences in air pressure and temperature, perceived in relation to objective space, represent volumes, differentiate open from closed-in areas, give clues to the structure of buildings and may come to signify architectural details and styles. Thus the child experiences the three dimensions of distant space.

A few concluding remarks may qualify, and perhaps clarify, the outlined development of those understandings that appear essential to topographical orientation. The order followed was derived from the order of development of the underlying motor skills and it was selected because it points out that in orientation the first and essential object of perception is the body, then comes space. This is an important point that must be taken into account in teaching orientation and object perception. The child does not experience space as such, or position, location, direction or distance as belonging to space: he experiences skin and muscular sensations which have an immediate meaning of position, postural changes, and motor activity. In the absence of specific stimulation the totally blind child would probably not walk, but rock or jump up and down or violently shake arms and legs in an almost spastic pattern. He must learn to walk and move freely, and he must be aware that his motor activity is goal directed before he can learn to perceive space, even the phenomenological space of concrete relationships.

Objective space is a perceptual abstraction: it represents the symbolic referent of spatialized motor activity — actual and possible — and therefore atemporal.

We have here an illustration of three perceptual levels. The first level is consciousness of one's own body as a physical entity, static and dynamic, and of illimited empty space, vaguely quantified by the temporality of movements. The second level is consciousness of relatedness of self and object, or particular space. This space is personal, structured by the particular perspective of the immediate situation. The third level is self-consciousness of the relationship

of the self qua spatial object and space, looked at from the outside by a self-subject. This level allows for a multiplicity of perspectives and results in a public space objectively structured. The immediate situation is only an accidental one among the many possible ones. At the first perceptual level the self is the creator and controller of an event; at the second level it has a role similar to one of the terms of a comparison; and at the third level, it is equivalent to the tertium comparationis (i.e., the essence of the comparison).

As a concrete illustration, one may think of a child trying to decide which is the right hand of a person facing him — or, for that matter, of any adult looking at the map of a strange city. The space of the first perceptual level is empty and private, completely exhausted by the duration of activity: it emerges as consciousness of one's own physicality (which is not yet corporeality or object in space and occupying space), as becoming form. On-going movement has the empty unstrutured space and time of form in the process of becoming. When movement ends it will have been a gesture defining a specific temporal duration and a space closed in upon the heavy, solid, self-same reality of the body. All that can be said about private space is that it "exists" as awareness of freedom and control of movement, of moving air, or of sounds. It may be centered on the skin surface or in the body, but there are no boundaries to this existential space. Objects are no part of it because any encounter, by barring freedom of movement, would put an end to that time through which this space existed. The centrality of the self to this perceptual event is represented verbally by the expression that refers to it, "Here I am": existence and presence are synthesized in one moment of consciousness. "Here", in this case, is the locus standi of the percipient at the particular time of this occasion or, in other words, is the point at which a self feels himself assuming the appearance of a particular, defined form. Since no outside relationship is implied, it is a private space.

The perceptual space of the second perceptual level, on the contrary, admits of another meaning for "here", that is, "not there". It identifies a perspective and a spatiality that includes two or more simultaneous events. Rather than private this space is personal, it is the subjective, individual mode of apprehending a place at one particular time. It may be a space of multiple relationships but the order by which these relationships are structured is the temporal one implied by the motor and/or locomotor activity of the percipient. They may appear simultaneous when recalled or imagined, but then they loose their spatial specific qualifications. The spatial relationships of this level can only be recalled as motor-temporal-tactual relationships, but then the subject must be integral part of the recollection — that is one must "feel" himself performing the spatial relationships, and maintain a constant perspective.

The space of the third perceptual level is physically bounded and characterized by relationships enduring through time. It is the space of locations perceived as stable container of multiple perspectives.

Object Perception

GENERAL CONSIDERATIONS:

To the distinction between subjective and objective space made in discussing orientation correspond the distinctions between obstacles and objects, and the more traditional one between the appearance of an object and the object-in-itself.

As soon as the blind child starts moving about, he encounters obstacles. They represent barriers to movement and are experienced as ways of bumping, particular localizations of a more or less sharp pain sensation. With the gradual development of orientation, he learns to identify them as locations, "things" in the way, and, finally, objects which may be wholly or in part investigated tactually. So the world of objects emerges at first undifferentiated, slowly becomes organized in motor-spatial syntheses, and finally is broken down in the individual spatiality of objects. "Object Perception" usually refers to this last stage but it presupposes the others, both in terms of the meaning of "object" and of "perception".

The distinction between obstacles and objects persists in the life of the blind person as the choice between two perceptual attitudes: in one, an object is a barrier in space and in the other, an object is a spatial entity that may have meaning in itself, in relation to the self, in relation to a particular experiential occasion, or as a symbol.

Perception implies awareness and goal directedness (intention), and includes physical, emotional, and rational elements. Particularly with the blind, perception, to be cognitive, needs to be conscious activity. Visually an object appears situated in an environment of objects and therefore immediately defined in at least part of its physical limits and positional orientation. This represents an external frame of reference to further visual and/or tactual exploration and the motor activity that accompanies it appears to consciousness as the structural spatiality of the object, immediately negated as motor activity. In the absence of sight, instead, an object appears as the subjective experience of skin and muscular sensations. Perception must negate its essential subjectivity in order to establish the external nature of the object. Qualities are then intentionally perceived on the object and progressively synthesized. This synthesis requires an impoverishment of the original sensations, a reduction of cues, as non-essential characteristics are eliminated and a simplified structure emerges which, in turn, is the basis for further reductions as structures are generalized into schemes and original elements acquire the simplicity of symbols.

The difficulty some blind children have in perceiving and ordering the space of objects, if not derived from structural peculiarities of the object, may be sought in the tactual motor activity of the perceptual process that reproduces the structural unity of the object. Order is, physically, the pattern of movements performed in investigating an object and the rule by which the data of this investigation are used. An object enters the experience of a blind child through a sudden contact which might be pleasant or unpleasant, and may be interpreted as a barrier to movement; in any case it has an affective value which must be isolated and negated to posit the non-subjective physicality of the object and make possible the interpretation of sensory data and motor activity in terms of textural, formal and structural characteristics envisioned on the object while taking into account the relationship between the pattern of tactual sensations and the motor pattern. This relationship is important because the tactual sensations are a function of a motor pattern felt internally but structured by the spatial characteristics of the object: it is through the realization of the externally determined direction of movement that the tactual data can be interpreted as qualities or quantities attributed to the object.

In discussing orientation it was observed that veering errors must be corrected prior to using direction to develop orientation. Observations of the same order may be made with regard to the movement of hands, arms, and body

that accompanies the perception of objects, for in this case, also, position direction and distance are the elements of the reproduction of a spatial structure: the object. Like orientation, object perception requires that the self be kept separate from its activity, continually, during the exploration. Like orientation, object perception requires the establishment of locations and the identification and memory of the relationships involving these locations. Again, like orientation, object perception results in an organized representation through the abstractive reduction of sensory motor impressions.

THE OBJECT:

Objects have characteristics that may help or hinder tactual perception. The first characteristics to appear are those of temperature, texture, and density. Any sudden passive contact with an object gives these first impressions which, because of their affective value, are important in determining the attitude the child assumes towards furthering investigation. The strength of these, or of any of these impressions may also determine the direction of the investigation: for instance, a tactually striking, pleasant texture may become the focus of attention in examining an object where textural changes are involved, at the expense of other sensations with greater descriptive value. Skin sensations remain dominant over temporal-motor ones and the object unfolds as a sequence of textural changes of varied quality whereas if, going beyond these first impressions, the object is examined with the intent of identification skin impressions become subordinated to and integrated with the spatial pattern emerging from the temporal kinesthetic sensations. Decorations, uniformity of materials, homogeneity of surfaces, compactness, and sizes are the characteristics of an object to acquire relevance next, and each one of them may, again, operate in determining the course and focus of further investigation. None of the characteristics so far mentioned gives information sufficient to the identification of the object, which depends on an analysis of the structure of the object. The complexity of this structure may vary greatly with regard to the number of elements it contains, with regard to the relationships existing between these elements, and, finally, with regard to the texture, shape, and size similarities of the various parts and of the parts with reference to the whole.

According to this order of presentation of qualities, an object is defined first as a surface, then this surface is broken down into a number of surfaces which are later defined into shapes and placed in that particular relationship of position that represents the form of the object. Implicit in this process is the shift from a two-dimensional to a three-dimensional space, from shape and area to volume and form. This shift does not necessarily appear at the end of the inspection — in fact it is to be regarded, and such it appears to be when tactual observation is efficiently conducted, as an underlying duality of perspective that makes possible the interpretation of two-dimensional data in terms of a three-dimensional space, so that the symmetry of the top of a wooden box may suggest an expectation of the equivalent symmetry of the bottom of the same box. The maintenance of this dual perspective depends in part on the size, structural complexity and integrity of the object, and in part on the approach of the child to the object. An analogy might be made, that the blind person, in formulating a percept of form and volume, is faced with a task similar to a sighted person's view of a blueprint which requires him to synthesize three two-dimensional perspectives (views) into a single three-dimensional perception.

Considering all the variations possible in each of the characteristics mentioned, it is evident that some objects may be perceived tactually much more easily than others; and it is possible to conceive of objects of such a tactual complexity that perception is impossible. Range and amount of experience play an obvious role in facilitating tactual exploration, and it was already pointed out how object perception is dependent upon orientation, both with regard to physical activity and to the formation of basic spatial concepts but there are other individual factors that need consideration.

POSTURE AND POSITION:

The space of objects is filled space in two ways: one, an object fills the space it occupies; the other, establishing tactual contact with an object fills the space between the subject and the object by incorporating the object in the physical framework of the body and by giving meaning of concrete spatiality to the movement that terminates with the contact. This corresponds to the effect produced by the eye movement in looking at a design composed by a curved or diagonal line and a dot to the right of it: The space to the left of the line is discarded, and that between the line and the dot becomes an integral part of the design as if structurally belonging to it. Modern art can furnish some good illustrations of the use of this effect in abstract compositions.

When a blind child comes in contact with an object he becomes aware of a physical spatiality that extends the limits of his body to comprehend the object. So the object is first of all realized as an internal presence. The position of the body in this case is perceived passively and regardless of body limits, for the body is localized by those same sensations that localize the object. Reflection and proprioceptive sensations of postural change will re-establish the integrity of the body and the physical independence of the object, while changes in position will give cues to the orientation of the object in relation to the self by introducing variations in perspective. Posture is relevant to object perception also because it determines to a great extent the range, freedom, and coordination of movement of the arms and hands.

THE HANDS:

The position of the arms and hands during tactual exploration has somewhat the same implications with reference to the parts of the object that the position of the body has to the whole. The hand that maintains a static contact with an object uncovers nothing about it for even the skin sensation of contact tends to disappear in a short time. Outward rotation of forearm and wrist (extraversion) affects perception, as it is accompanied by an exaggerated outward extension of the elbows that can hardly be taken into account in the interpretation of motor patterns and that results in fore-shortened perspectives and in the curvature of straight lines and surfaces, even of limited extension and even if well within the brachial space of the child. This position of the wrist, as well as that determined by inward rotation (introversion), modifies and limits the range of movement of the thumb and therefore its usefulness in estimating sizes.

The use of both hands simultaneously in opposition and in alternate positions establishes relationships of location of parts, corrects directional errors originating from slant in reaching, and defines areas and volumes. Exploration conducted with only one hand, or with either hand subsequently results in a temporal pattern or in a spatial sequence. A temporal pattern is a tactual-

motor sequence which may represent the absolute position — but not the spatial interrelation, of several elements in a time sequence order. A spatial sequence disregards the orientation of the parts and of the whole, and only maintains the relationship of contiguity between single aspects as the order of representation, thus failing to achieve a synthetic unity.

In exploring an object the hand may be used as a whole, without wrist and finger articulation, so that contact is made with the wrist, the palm, and the whole length of the fingers while the thumb is either not used or used in opposition to the palm rather than in opposition to the fingers, as in grasping a book or a dish from the top. The whole hand approach to an object is, in fact, characteristically an approach from the top, and it results in the perception of density and possibly of thickness and rigidity if the object is thin enough for the thumb to fold under it. Since in this case two opposite sides of the object, or the two faces of the same surface, are touched simultaneously by the same hand, no differentiation between them is possible. Although this approach is from the top, it does not furnish sufficient elements to suggest the height of the object because the downward movement of the arm and hand is ideally completed and referred to the axis of the body. Height, length, width, extension and volume are signified by combining the relationship of distance and position of the hands throughout the exploration of the object.

When the hand is used as a whole and the surface touched fits the size of the palm so that the fingers can fold down, the slight arching of the hand that accompanies the folding of the fingers produces what may be considered a tactual illusion of convexity.

Articulation of the wrist and of the fingers allows the hand a variety of positions that facilitates the exploration of objects. The efficiency of the various positions is relative to the characteristics of the object and cannot be discussed in abstracto, however, it is important to note that the independence of movement of fingers and thumb within the natural relatedness immediately existing between the five positions at each moment attained (finger tips and thumb) offers the possibility of structured synthetic prehensions.

Similarly, some small objects may be immediately recognizable to what may at first appear as static touch when the hand completely envelopes the object, provided that synchronous impressions are spacially differentiated and localized. The shape of the object is in this case of peculiar importance.

TOUCH:

Tactual elements are differentiated because movement provides change in the quality, intensity, and location of sensations. The nature and function of motor patterns was above identified as the substratum of structure. It is relevant now to examine what various types of movements signify in terms of sensory experience, that is, what type of tactual experience is possible, and to what extent, in relation to specific types of movements and motor habits.

Touch may be sweeping, grasping, a combination of both, structuring or metric, from the standpoint of movement. It may be random or intentional, and even when intentional, may be directed at the surface, density, size, direction, shape, proportions, relationships between parts, or structure of the object. It is possible that all these aspects and intentionality of touch enter in the perception of an object. It is important to understand what each one of them can contribute, and possibly how, in the absence of the others for this may

help us to clarify the meaning of the tactual appearances of an object to a blind child.

Sweeping touch: The fingers or the hand move over a surface or a line with a minimum of pressure: this movement may start at the elbow or at the shoulder and in either case it implies rigidity of the wrist and a broad circularity of motion. This touch gives an impression of the homogeneity of the surface, more or less limited, depending on whether the whole hand or only the finger tips were used. Some children use only the index finger, usually of the right hand — commonly the motor hand — while holding the other fingers up with the wrist somewhat extraverted. This position can be often observed in children reading Braille and may be due to the fact that the area of greater sensitivity in their index finger is located towards the left side rather than in the middle of the pad. Since this position of the hand does not offer any other contact with the page that could be used as a guide for following a line or dropping to the next, uniform direction is maintained by a postural adjustment whereby the body is twisted at the waist towards the left and often supported by the left arm on the table, while the book is slanted upwards to the right. The movement of the right arm starts at the shoulder with elbow and wrist held at a constant angle and the finger moves straight across the page. If this movement were extended it would result in a movement of the trunk, rather than in the extension of the arm, thus maintaining linearity. If the angle of the elbow changed, as it occurs when the arm is held close to the body, the resulting movement of the hand would be rotatory and this would increase the difficulty of following a line (convexity effect), and would necessitate the use of the other hand to help locate the next line. This approach to Braille does not necessarily imply poor reading skills although it has its number of poor readers. It might be noticed however that for the beginning reader, and for the poor reader who may have difficulty in recognizing dot formations of single cells, this approach results in additional movements back and forth across the cell (when the pad of the finger is used the movements tend to be rotatory) so that the pattern of dots is each time reversed and understanding is not made easier. In this case the difference between a rotatory and a back-and-forth movement is made more significant because it is related to pressure changes. Further study of this area would be justified for the implications this position has for body posture and for tactual efficiency. In this connection some thought should also be given to the format of Braille books and to the criteria underlying the spatial organization of the page, especially in pre-primers and primers.

In the exploration of an object sweeping touch uncovers nothing about directionality or length because the movement is ideally continued along a straight line or a curve depending on whether the shoulder, elbow, and/or wrist are rigid or not. Movement has, at any time, a retention and a protention quality which sweeping touch does not modify so that tactual and motor sensations are not synthesized but remain in turn affective and kinesthetic (lacking, that is, representational value). The blind child however will interpret his sensations as qualities of the object, and describe it as smooth, hard, flat or bumpy, round or straight. The amount and consistency of pressure used in sweeping touch may produce an inference of flatness. Sweeping movements are often from side to side but occasionally a child shows a definite preference for movements towards and away from self, or from top to bottom. This fact does not change the results of sweeping touch but points to a definite

directional orientation to the vertical which is accompanied by lack of understanding of the concept of perpendicular. Similarly, a child may be oriented exclusively to the horizontal. It is doubtful that this may be a result of poor wrist articulation, though this is a concomitant finding. Body and object orientation is made impossible by this one-dimensional behavior. In the light of the preceding discussion on orientation, it is reasonable to suggest that limitations in motor activity in early life may account for later uni-directionality.

Grasping touch: Fingers and thumb, in opposition, follow the outline or surface peculiarities of the object or, when this is sufficiently small, fold completely around it, passing from grasping to enveloping touch. Grasping touch may accompany sweeping movements and represent dimensions of length and possibly extension of surface. In this case, the larger, sweeping movement is terminated when the fingers, in reaching the end of the surface or object, fold upon themselves. The movement and the termination however do not become synthesized and are represented as separate elements. This is an effect similar to that produced for vision by an angle topping a line and, in a way, the similarity goes farther because the closing of the fingers gives the tactual illusion of an angle, or, in the language of the child, a point. Lack of synthesis in this case may be due to the different origin of sensations represented as line and point with the predominance of tactual elements in one case and motor elements in the other.

The articulation of the fingers and thumbs is important to the relative efficiency of grasping touch as it determines how well the motor pattern may be defined, and how clearly sensations may be distinguished, in relation to one another, and synthesized in relation to the motor pattern. So from grasping touch, in raising degrees of efficiency, one passes to structuring and metric touch and from representations of extent of surface, length, and consistency of texture and material, to the representation of structural relationships and finally of proportions.

Structuring touch: Structuring touch is analytic and synthetic: both hands are used in the active exploration of the object to comprehend volumes, maintain the orientation of the object while breaking down the surface into planes of various directionality, define planes by their shape, refer directions and shapes to symmetry and volumes, to reach a representation of the form of the object. This process requires not only the awareness of tactual sensations, as sweeping and grasping touch do, or the awareness of the relationship of touch to motor activity, as in sweeping-grasping touch, but also the awareness of the object-directedness of the motor pattern which thus acquires symbolic value with reference to the structure of the object. Movements not required by the structure of the object but intentionally directed at the exploration of details or at checking back, do not break the unity of the motor pattern and analysis takes place with the awareness of the presence of a synthetic structured unity, and with the expectation that the completion of any analytic exploration is a new abstractive synthesis. The representative value of the motor pattern itself is transcended in the emergence of form, which is the meaning of the object qua spatial pattern. The tactual muscular sensations accompanying exploration, are realized as qualities of the object and organized in terms of this specific form in a synthesis of spatial and qualitative values which is the meaning of the object. The object is thus comprehended or learned, it can

be named. Metric touch adds to this representation the specificity of proportions that identify the particular object and at the same time make possible class generalizations and future recognition.

As the various aspects of an object are observed intentionality anticipates a possible order and envisions an object which actually is the phenomenological object, or, in other words, it is the object under the guise of a particular appearance in this occasion of experience. This may be called a percept. As such, this object is real, though not necessarily the object-in-itself which is less, and perhaps other than, its appearance or plurality of appearances. To know the object-in-itself is to reach a synthetic unitary representation of it outside of any perspective. Structuring and metric touch go beyond the immediacy of perceptual representation and rationally analyze spatial relationships and proportions to uncover the order by which these data may be organized in a representation of meaning. Perception ends when knowledge begins with the abstractive synthetic reduction of percepts to a unitary image that recreates the object as a totality posited as absent and non-spatial (i.e. non-phenomenological). The same object appearing in a new occasion may be immediately recognized but then the percept is regarded as symbolic of the object.

The preceding pages have attempted to describe the relevance of the object and of motor, sensory, and mental activity to perception and to show how each perceptual element may be influential in determining the meaning of experience. It is now necessary to examine the role of language in perception and in the organization of space.

Language

Blindness limits the experiential environment of a child to the space of his actual movement and to the space that he can, at each moment, comprehend with his arms. Currents of air and sounds enlarge this space but during the first years of life, and in some cases for many more years since, they do not convey informations about the spatial environment. A voice at first signifies body sensations, then it identifies a person, then perhaps an affective state, then, slowly, becomes distinctive sounds and words that the child learns to comprehend as sensations first and as nouns later. Speech develops as hearing becomes attuned to finer discriminations.

Music or in general rhythmic sounds are often translated in rocking movements even by very young children. Other sounds, such as steps, bells, barks, etc., have an emotional significance and eventually become associated with words only indirectly related to them. The blind child learns that sounds signify the presence of a person or of an object only when he has identified the sound together with a direct physical contact with the person or object. As he begins to walk he may realize that presence at times implies distance, and use sound localization as a means of orientation, but localization remains vague and its use probably unconscious. The voice of an adult may appear to a child to come from a place quite unrelated to the place where the adult is: for him the height of a person is probably determined by the height he can reach with his arms. A blind child, to use the spatial clues of sounds, must know the nature of the sound, its direct and indirect course. Language usually is far too vague and inexact to help, as for instance when a mother explains the noise of a key turning in the lock by saying that "father is coming in". Similarly a bark is a dog, a ring is a bell, a siren the firemen and neither the

dog, the bell, or the firemen are anymore or anything else than the noises that have been given their names, while the noises themselves have acquired the concreteness and identity of their source or of their causes. The child learns to use these words and is capable of communicating but may even never discover the difference between a bark and a dog or he may, later on, become aware of some ambiguities and find it very difficult to explain what he means or to find the source of his errors.

The child's own experiences do not correspond to the explanations that often accompany them, for instance walking is coming or going, sitting in a car is taking a ride or going to visit someone, getting out of a car is arriving somewhere. As he grows and his learning becomes more verbal his perceptual world becomes disassociated from language. When language is deprived of its symbolic intention the child finds himself unable to express and communicate his perceptual experiences or even to understand their meaning. Throughout centuries of civilization there has not been one congenitally totally blind poet or writer of some literary merit, and one may assume that this is not due to the fact that blind people have nothing to say. The same holds true with music: there are many blind players but not a composer of renown. Sculpture is the same. It is not that blindness deprives a person of his creativity or sensitivity, but rather that the blind child may be unaware of the possibility and the means of self expression.

A child is given a spoon and told to put it in the dish but the hand that guides him pushes his own hand down and he eventually learns a movement which is "the putting a spoon in a dish". When the size of the spoon or of the dish changes and his gesture loses efficiency he has no way of correcting it because he has no idea of the relationship of the spoon to the dish and of his movement to the position of the spoon. Someone may give him verbal directions such as "higher" or "lower" or "hold it even" and he will be confronted with the task of interpreting these words in terms of the movements of his arms, which to him are purely proprioceptive sensations. Eventually he will learn the movement and that movement for him will be expressed as "higher", "lower" or "holding a spoon even". The same directions given when he carries a dish however will result in a movement that this time is the wrong one, and he will learn another movement, "holding a dish even". So, often, when he tries to apply language to experience he must conclude that neither language nor experience can be generalized, but that every instance of experience corresponds to an expression or word, and, conversely, that an expression names an experience, as his own name him. Also, looking at it from the standpoint of language he finds that not the noun, nor the verb, nor the adverb, nor the adjective are what make the difference or directly explain his experience, as for instance in the two expressions "hold the spoon even" and "hold the dish even".

In school he learns that north, south, east and west are directions and that North is stretching your arms straight in front of you, and South folding your arms back towards your body keeping your hands together. He has learned to find north and south and that is what "directions" mean and to "go north" or "go south". Another child realizes that when he stretches his arms to "find north" he touches the map on his desk, just about in the middle of the top edge, so all he has to do is find the middle: start from the edges of the desk, or the map, at the same time with both hands and move them towards one another till they meet, and that is where and what "north" is. And "south" is the middle of the bottom edge, "east" of the edge to the right and "west"

of the edge to the left. Once you use your right hand, the other time the left, go up and down along the edge a couple of times then half way as far, just don't stretch your arm all the way, and that is where "east" or "west" is, and that is what "the middle" means. Now he knows what it means to be in the middle of the play ground or in the middle of the room: stretch your arms straight in front (or straight across) and let them fall down along your body and you know that you are in the middle. It is the same thing to sit in the "middle of somebody", like in the car or on a bench. The edge is a different thing from the middle, it means that you fall off, sometimes only your arms, as on the (top of the) desk sometime all your body as on a sidewalk or the swimming pool: you walk straight ahead or move your hand and then you fall off, and that is what "edge" means. It is easy to tell that the desk has two edges and a point, and the point is also called the middle. The top of the desk instead is all round one could also say that it is square, though, or rectangular, it is the same thing: the hands move round and round on it. It is also flat, or one could say slippery or smooth or narrow. It is the same thing with the face, it feels flat when you put soap on it. Finger painting as he used to do in kindergarten is flat and round too, most things are.

A small child talks about his world and sometimes he makes sense, sometimes he does not and often he is told "we don't say" this or that way, "we say . . ." and he learns to say as "we say", and because what "we say" is different from what "it feels like" it is only confusing to try and find out what things "feel like", and also the things he knows from what they "feel like" "we" call by another name, like "putting the spoon in the dish" actually feels like going down, or "crossing a street" really means stop and listen till there are no cars then walk straight ahead.

The preceding illustrations of some differences in the perception of a sighted and a blind person try to show the function of language in the experience of a blind child and to explain why some children with very high verbal ability may not be able to follow simple directions or perform efficiently and independently the tasks of everyday living. The examples cited were derived from responses given by children during the course of this study.

METHOD OF TEACHING

The experimental nature of this program suggested the desirability of manipulating the order of presentation of the various phases with the possibility to gain some information with regard to transfer. The groups, however, were not sufficiently homogeneous, nor the total time allowed sufficiently long to warrant comparisons by statistical methods. From the standpoint of teaching the sequence suggested in the preceding outline was found to be the easiest to follow with a young group as it is closely related to the development of motor and language skills. When older children are concerned, however, several factors must be taken into account in selecting a starting point if the program is taught as a "special" program. Factors that were felt relevant during the course of this experiment are chronological age, intelligence, degree of academic retardation, homogeneity of the group in relation to the preceding factors and to areas of individual difficulties in spatial organization. In some localities, season variations must be considered, too, in relation to time allotment and facilities available. In some cases, it is possible to follow the regular sequence but approach it from the standpoint of language rather than activity and use activity to demonstrate meanings and illustrate alternatives. This approach may lend itself to a greater integration of the program by cutting through all the phases at various levels, i.e. motor skills, balance, posture, direction, position and developing each in terms, i.e. of shape or form thus at each level integrating aspects of perception of self, of space and objects that may come under the same verbal heading. Since this approach may at first be very slow because of lack of skills, careful and repeated interpretation of the aims of the program is necessary. In some cases, language may be considered too abstract a starting point and each phase either too childish or possibly too frustrating, it may then be desirable to start with some simple practical task, i.e. making peanut butter sandwiches to introduce the idea of surface, the use of a knife in relation to this surface in two different positions, to spread and to cut. Bread has texture and shape, the latter is varied and changed at will by cutting. A sandwich is cut in half across from side to side, from top to bottom, or diagonally and, if the timing is good, it is a high interest subject. Activities of this type at the beginning of the program have a psychological advantage while offering the opportunity to observe specific needs, individual attitudes and understandings. They may also motivate further practice and encourage confidence in progress.

The outcome of a program of spatial organization depends to a great extent on the children's understanding of the purpose of the activities performed as they are required to examine their motor and verbal habits and in many cases change them, at times, to carry out activities they would ordinarily label "babyish" and may instead recognize as meaningful and desirable in terms of their present problems. The attached lessons on veer correction and on the use of sounds illustrate this point.

Another point worth making because often overlooked in the education of the blind child is that the continuous repetition of an activity once learned does not result in reinforcement nor reduce forgetting as evidenced by the fact that a poorly oriented child may be taught to go from one place to another but even though he may go every day to the same place, he is not learning his way better, rather he is gradually forgetting it and eventually has to be taught again. The teaching of orientation should help the child find those perceptual clues he is capable of interpreting and remembering. He may be helped by

perfecting motor skills, understanding the meaning of postural shifts, correcting veer, maintaining balance and direction, learning to synthesize tactual-kinesthetic sequences into spatial patterns through schematic drawings but he will have learned a method for finding his way around only when he will be able to select and use the perceptual clues the environment offers, for then he will be able to check on his errors. Whether he memorizes a particular route and can remember it through the years or learns it and forgets it within a few days is for the purpose of this program completely immaterial. This same consideration holds true for all phases of spatial organization and this, again, points to the importance of the child's attitude, and since learning to please an adult, teacher or parent, in this case has absolutely no value for the child, to the teacher's responsibility in a program of this nature.

It is now possible to supplement the very brief outlines of the phases of the program already given with more concrete descriptions and specific suggestions of activities that were found useful and appropriate during the course of this experiment. Each phase is presented as if it were the first one.

Phase one: POSTURE, POSITION AND FLUIDITY OF MOVEMENTS

Awareness of posture and fluidity of movements depend to a large extent on the child's attitude towards space: unless he is sure of his surroundings, and feels safe in moving about he is hesitant and slow in his movements and more concerned with fear of obstacles than with proprioceptive sensations. It is important, therefore, to introduce the child to the training room pointing out empty spaces, walls and furniture, encouraging him to walk around, explore the room, reassuring him and vocally guiding him. After this has been accomplished, and it may take one or more periods, it is desirable to establish one point of reference. Lesson plan 1 suggests a way of doing this: in this case, the reference is given both to the wall and to the other children to facilitate the task of remembering and to encourage awareness of the others in the group. This point of reference is helpful at the beginning, mostly to give the children a feeling of continuity from lesson to lesson, a place to start from, and to go back to. With younger children, this is important and often also with older groups as this program deviates from the more orderly and rigid routine they are used to. Rolling on the floor, walking on all fours, imitating trains, running all together, standing and lying down side by side, walking holding hands with outstretched arms are all activities that help the children to evaluate the empty space of movement and gain assurance of the evenness and solidity of the floor. As they acquire confidence, they can be encouraged to run alone and specific instruction may be given. Imitating animals' ways of walking and movements of toys stimulates imagination and helps control of movements. Rhythmic music, clapping hands while walking, and in general all games suggested for young children may be used to teach the children to stop and go, to listen, get ready, alternate fast and slow movements, etc. More specific postural exercises may be found and adapted to individual and group needs, not necessarily as corrective training often specifically provided by a specialist, but rather to develop awareness of sensation, to explain meaning of position. This is especially important with children who often sway back and forth or sideways. Position may be stressed by emphasizing range of movements and limitations when the child is standing facing a wall, with his back to the wall, or lying on the floor. To encourage differentiation of "stiff" and "relaxed" it was found useful to have children play a relay game, sitting on a chair, picking up the ball between their feet and passing it to the next child

by rotating towards him. The aim was not to let the ball fall and, naturally, speed. Walking on tip-toe with stiff legs, hopping and skipping often needs to be taught together with the meaning of stooping, bending, squatting, etc. Activities learned indoors should be repeated outdoors. Vocal contact in running is at first essential but at the same time the children should be encouraged to follow sounds (steeps, bells, etc.) then to move as quietly as possible and listen as carefully as possible. In general, each lesson should try to relate freedom and control of movement to postural sensations and the cessation of movement to position not only as static but as oriented, as i.e. facing a wall, beside a table, etc.

Phase two: STRUCTURING EXTENDED SPACE.

Extended space, or surface, is made up of a series of distances in a continuum of directions. The shape of a surface may or may not be important in itself, it depends on its size. If shape is important, the surface is limited by a perimeter which, in some cases, is all we know or need to know about a surface but this reduces the surface to a "road around" and possibly "roads across" it. This is true for the space of locomotion as well as for the brachial space. This phase of the program is concerned with the development of the concept of surface as something extended, even, stable and enduring; with the understanding of direction and location; and with shape. It also aims at showing how these concepts may be transferred from larger to more limited space.

Activities to demonstrate the meaning of surface may include rolling on the floor, walking on all fours, chasing a ball or a marble, games such as relays and passing the ball, rolling it and throwing it to children at different positions each time vocally identified. Occasionally metal balls or heavy wooden ones should be used and the sounds and echoes made by the different size and different material balls recognized and used in following and retrieving the ball. Rolling objects on the floor should also give impression of smoothness which can be reinforced by stressing the difference with the noise made by objects sliding. A board with raised rims may be used on a table or on the floor for marble games with children on all sides, to shift to a more limited space. It is important that the children represent these various experiences by means of drawings on mylar or symbolically using sticks or ribbons or other markers to show the place of the players as well as the route of the ball. Clay on cardboard mats may also be used but perhaps drawings are the most efficient means to bring about a synthetic impression of the whole situation. Children learn quickly to use the mylar and soon begin to invent their own symbols to represent people and movement. As the children play with the ball or with cars sending them from one to another alongside and across the floor or the table particular care should be taken to identify the various positions and directions, the order of the game changing often and the children should learn to use the correct words to indicate relationships such as across, to the right, to the left, etc., with regard to themselves and to the other children. Placing a small bell in the middle of the table or of the floor space and attempting to hit it with a ball, or similar games offer a good chance to identify various positions and directions with regard to an object other than the children. Have them describe their drawings using correct terminology. From this it is possible to introduce the concept of veer and clarify the meaning of "going straight". It should be made clear also that to say go straight is not sufficient, and also the direction of going must be stressed, such as ahead and backwards, towards the table or the door, away from the wall or the other child. The blind child may

not be spontaneously aware of the fact that in going towards a place he is at the same time getting farther away from the starting point but this is the first step in objectifying the space of locomotion. Ribbon may be useful in helping a child retrace his way or realize distances. If a ribbon is anchored at various places while a child walks around a room he may be able to identify a shape that he has walked, and compare lengths of sides, two sides and diagonal. Finding himself within the space enclosed by the ribbon may reinforce the idea of shape as space enclosed. Ample repetition should be given to this type of activities, gradually extending the area of movement and each time encouraging symbolic, graphic or otherwise, reproduction, to reduce the space of locomotion to brachial space. The meaning of straight that applies to walking also applies to drawing and in both cases posture should be carefully observed.

Veer can be explained rather simply as shown in the attached lesson plan, which was used with children of varied age groups: the smaller ones viewed it as a game, to the older ones it was introduced with an explanation of the purpose. With either groups results were good, the children appeared to understand and soon began to practice outdoors in going from place to place and asked to be observed and corrected. This lesson was repeated periodically till the children were aware of postural shifts accompanying veering and began to be able to correct deviational errors. Again drawings accompanied activities to illustrate meanings and view the situation objectively. No attempt was made on the part of the teacher to present the children with ready-made drawings because it was felt it would take a much longer time and more experience before the children could interpret a drawing made by another person. They drew the various activities themselves, and whenever they were not sure or appeared confused in explaining their drawings, activities were repeated and followed by new drawings.

Instead of drawings sometimes children were asked to represent a situation or illustrate spatial relationships by acting it out with the help of the other children in the group. So a shape could be represented by locating children at the corners or along imagined sides with their arms stretched out. Locations were indicated by sounds. Guessing games are possible and usually well enjoyed: four children representing the angles of a square make the same sound at the same time and a fifth one guesses the shape, then the children move to form another shape or one remains silent and the square becomes a triangle. Interest and novelty are great helps in stimulating quite refined differentiations. Acoustic shapes may be used also to point out relationships of inside and outside of buildings, identifying and locating windows and pointing out size of buildings. This is important because children do not seem to be aware by walking subsequently in different rooms, of the contiguity of rooms, of the orientation of the rooms in regard to one another and with respect to the outside. As they become aware of these relationships the first maps may be drawn, with sticks and ribbons and wires or on the mylar. Buildings may be represented by real brick walls on the floor, smaller bricks or blocks on tables, and clay structures. It is important to proceed gradually from as complete and realistic a representation as possible to a more schematic and symbolic one. When the children have had enough practice it is possible to use abstract shapes to indicate locations, as from buildings one passes to playgrounds and campus. The use of symbols marks the passage from a motor and temporal approach to a truly spatial one. Ribbons and drawings usually indicate paths, corridors, streets or ways to go from one room or building to another but a

square symbolizing a room is a definite location and whatever is built around it should be in terms of locations, and exact relationships should be stressed. If possible, models should also be used. Throughout this phase pointing, turning towards places and verbally describing directions and locations should be stressed. Turning may require special training especially if children tend to sway: from standing still in a position easily identified they must learn to turn right and left: this is quite difficult to learn and to teach. Older children may be explained the meaning of turning around as different from turning right and left in terms of degrees, but in general a mechanical approach is needed in all cases. During this experiment it was found possible to give the children some understanding of the amplitude of an average right or left turn by breaking down a continuous turn-about into four steps so that after four partial turns they would find themselves in the starting position. When the child has the habit, which was found frequently, of swinging his whole body from the shoulders and rotating on one heel, he must be shown how he can turn by changing the position of his feet, at first one foot at a time, then normally both. With older children it may take quite some time before a 45′ degree angle is mastered, even though they may be quite able to define a 45′ degree angle verbally. A compass and again mylar may be of help to exemplify meanings but actual practice is needed to correct a faulty and learn a new motor skill. Younger children appear to learn more easily, motorially at least. This suggests another observation: turning may be emphasized also in having the children walk around a table closely following the sides and the corners, provided they are able to maintain the same position with respect to the table. All too often they follow the sides of the table walking sideways. As it was mentioned earlier in this report the child learns slowly and needs to be taught to view objectively his position with regard to other objects as he usually tends to refer all positions to himself. Maybe this concept of the reciprocity of positions is difficult if not impossible before six or seven years of age, however, some children appear to develop it earlier, at least at a functional level. Doll play, puppets and some of the ball games mentioned earlier may prove of value in helping the younger child to view a situation as "facing" him. Another game that arose great interest was "pat-a-cake". Naming the hands and frequently changing places may help. In a similar way may be used a stable source of sound, such as a clock or a timer, having the child walk to it, passing by it to the right and left, etc. A continuous description of the activity while it is taking place is essential.

Phase three: PERCEPTION OF OBJECTS

This series of lessons is specifically concerned with the space of objects. It purposes to teach children to observe and identify objects through the selection and analysis of their tactual characteristics.

A. 1. Density: Presentation of objects: things we eat.

2. Observation of differences in density: liquids we sip, other things chew, others are too hard.
compare: water, orange, apple, marshmallow, bread, lollipop.

(b) Some things we can squeeze, others cut, break, poke. Things are spongy, rubbery, stiff, etc.

3. Collect items of different — similar densities.

4. The same material (i. e. rubber) may have different densities in different objects. Relate density to: use of objects, types of materials.
5. Changes brought about by heat and pressure, and water. What happens to the bread left in the air, toasted; to the lollipop left in a glass of water, to a candy bar on the radiator, etc.

B. 1. Presentation of common-use objects: things we eat
things we wear
things we use

2. Analysis of textures: the way things feel.
    1. Wet or dry, sticky or smooth (soapy), slippery
    2. Smooth, rough, wooly, silky, prickly, velvety, waxy, furry, stiff.
3. Naming textures and classifying objects.
4. Using textures to represent objects: symbolic use of materials.
5. Textures vary but some types of objects (i.e. fruits) always have the same texture: texture as basis for recognition of objects.
6. Some textures are more pleasant than others. What textures we remember more easily.
7. Some objects have different textures in different parts, i.e. fruits. The whole object should be explored.
8. Textures suggest types of materials but are not sufficient to identify materials or objects. Painting, sanding, wetting, scratching, etc. change the way things feel.
9. Application: Matching textures, reproducing, changing textures, collecting objects with the same textures.

C. 1. Shapes: Presentation of objects: things we eat
things we use (tools)
clothes
furniture

2. Naming shapes and classifying objects by shape; round, spherical, eliptical, cylindrical, conical, rectangular, square, oval, etc.
3. Generalization: grouping objects with similar shape.
4. Shape tells something about the use of objects: dishes and cups, forks and spoons, handles, keyholes, knobs, soap dishes.
5. Regular and irregular shapes: The need for exploring the whole object: How to touch.
6. Objects are often made of parts: each part has a shape different from the object as a whole: taking objects apart: orange, lollipop, corn from the cob, pages from a book, etc.
7. Our body is made with parts of different shapes: hands and arms and legs. What are they like?
8. Our clothes have different shapes and are made of parts. Some parts are alike: sleeves, etc.
9. The shape of things make them do different things: something round rolls, flat things slide, etc. What happens when things fall: how to look for things. How do we fall, roll, curl up, stand straight, etc.

10. Shape of containers: things that fit inside, i.e. feet and shoes, hands and gloves, jelly in a can, shoes in boxes, etc.
11. Applications: recognizing objects by their shape, parts that belong together, identifying shape of different parts of objects, changing the shape of objects. Making shapes with different materials, two and three-dimensions, making molds. Recognizing pleasant and unpleasant shapes, appreciating the effect of sudden and slow variations.
12. Using shapes to symbolize objects.

D. 1. Sizes: material: id.
2. Compare a sip, a mouthful, and a glassful of water; a peanut and a mouthful of peanuts: a little and a lot.
3. Big things and little things: the clothes of a child and the clothes of adults (large ones that is). Baby's first shoes and the children's.
4. Things of the same shape and different size: tables, etc., fruits, dishes and cups.
5. Some things are so small we can hold them in our hands, others we can hold with our two hands. Other things are so large we must use arms, and sometimes they are too big for us to touch them all over. Recognizing little things: general shape and larger things: details in relation to general shape.
6. The size of parts gives one knowledge of the size of the whole. Little feet and little people, etc.
7. Size alone does not help much to recognize objects but helps to identify them and compare — i.e., the size of a pair of shoes, gloves, the size of things that fit together.
8. Touching for size: maintaining constant one relationship, touching for shape and size: symmetry: using metric touch, the hand as a gage and two parts of an object as standard for the others. Differentiating enveloping touch from analytic touch. Movements help to determine size: length of table.
9. Size appears different to different parts of the hand (palm gives enlargement): the use of fingers and wrist in touching.
10. Reproducing sizes through gestures and motor activity. Making things of different sizes, grouping things by size.
11. Size as an element of orientation: big things never move, larger things at the bottom and smaller things on top, the outside is larger than the inside. Things can be ordered as to size.
12. The size of an object and the material it can be made out of: usually, the bigger the object, the stiffer and harder the material. The size of many objects is related to their purpose, and the use we make of them.

As this phase of the program develops, it is possible to relate the structure of objects to body space by imitating with attitudes and positions the relationships between parts of objects, such as perpendicular, parallel, at right angles, etc. Paper and cardboard constructions were found useful and interesting to use, and some of the children spontaneously transferred the same idea to building with clay, joining faces, regulating sizes of corners, schematizing more complex shapes towards geometrical simplicity. Differentiations between shapes and forms became soon spontaneous as the childreen understood what was better represented with drawings and what with plastic or solid material.

Interesting were the drawings of cubes, cones, cylinders and simple objects some of the children attempted. They started from representing separately the various elements they had uncovered, then organized them as if the object were open, and gradually sought to represent relationships as they appeared in tactual perspective thus producing drawings that strongly resembled visual perspective drawings. It is interesting also to note that the younger (5½ year old) children when first beginning to draw started with scribbles and within 4 or 5 months passed through the normal scribbling stages using lines and circles to illustrate stories, and gradually mastering control of movement and pressure. Some of the older children went through the scribbling phases very rapidly but in most of them the same development may easily be seen.

Copper sheets with line drawings were presented and left around in large numbers to encourage children to explore them. The children did some copper drawings too, especially when they needed to learn to use more pressure and evenness. On the whole, copper has the disadvantage of reversing the drawing and is therefore less useful than mylar.

Phase four: LANGUAGE

This group of lessons is specifically concerned with structured space. It purposes to teach children some of the ways in which space is organized and to clarify, through experience, the meaning of words that, because of their visual character, are often ambiguous when applied to the experience of the blind child.

For the purpose of these lessons structured space will be considered as the relationship of: 1. linear space or direction and distance, 2. Position, absolute, of self and of objects, 3. relative position, self and objects, 4. relationships between locations, enduring, and 5. internal organization of objects. There are certainly others, and perhaps more important aspects of spatial structure but these were selected as the simpler to teach to young children with the method suggested.

1. *Direction:*

   Static: facing the wall, facing a person, facing the sun.

   Dynamic: walking towards the sun, walking towards a person, towards the wall. Pulling and pushing. Pointing. Reaching in front. Stopping in front of something.

   Vocabulary:

Facing	Ahead (straight ahead)
towards	here
forward	there

2. *Direction:*

   Static: right and left side of the body, right and left hands. Standing beside wall, person, etc. to the right and to the left. Swinging right/left arm.

   Dynamic: moving to the right, left, turning to the right or left, pointing towards the right or the left. Walking to object on the right or left. Swinging body from left to right, turning knobs.

   Vocabulary:

to the side	Beside
right-left	direction

   this way, opposite way.

3. *Direction:*

Static: standing against the wall, laying on our back, standing behind somebody, having somebody in back.

Dynamic: bending backwards (literally), walking backwards, swinging arms towards the back, back and forth, walking back and forth, swinging body back and forth, swinging on swing, swinging a pail of water. Carrying a sack on our back, dragging, pulling, etc. Reaching in back of object.

Vocabulary:

around
backwards
away from
backing up and away
against

4. *The cardinal points:*

facing the sun: the sun as point of reference to determine our position and the position of objects (here position is only used to mean: what side we are facing). East and West: morning and afternoon. The sun in the room: when and what it means. Right and left, and North and South. Facing the sun and turning around. Turning the right side of our face towards the sun, the left side and facing North or South.

When the sun shines on the front door, the back door of the house is in the shade (timing of this investigation is most essential).

A building has a front and a back, like we do.

A building never (hardly ever) moves so each side of the building always faces the same direction. Orient building. Dramatize meaning of "facing" and distinction between front, back, and sides. Sandbox or table demonstrations or relationship of sun to building at one given hour of day.

Vocabulary:

Cardinal points, names.

5. *The cardinal points as indication of direction (as other than position):*

Buildings do not move, roads do not move. Like the building, roads are laid out in a certain position so that each side is always turned to the East, the other to the West, etc. Lay down on floor to demonstrate the four sides of a road and why we walk North and South, etc., but walk on the right-hand side or the left-hand side of the street. Demonstrate also spreading roll of paper on the ground. Emphasize: going towards East, going West as walking in a certain direction. Give a lot of practice.

6. *Distance:*

People can be so close that they touch, so crowded that they cannot move, and they can be a little apart so that they can touch one another only if they reach out, or so far apart that they cannot even reach, even if all stretch their arms out. The same thing happens with the wall, the door, the table and with our hands when we clap them: first they are apart then we bring them together and they make a noise. Objects can be close together or far apart, like homes and people and your hands. The sides of an object can be close together or far apart, the edges of the table so that you have really to reach far away to touch the edges with your hands. Things can be far enough that we cannot reach them from where we are but near enough that we can walk to them, or so far that we

cannot walk to them but must ride or fly. Then there is a great distance between them, and we must go a great distance before we get to them, like many of you travel a long distance to come to school or to go home. But when we travel the distance becomes shorter and shorter till we are almost there, and then we are there, and there is no distance any more. (use demonstration of road again) Demonstrate with string held by one child while the other child walks away unfolding it.

Vocabulary:

together (spatially)	apart
Between	close
nearby	edge
end	opposite side

7. *Distance and direction:*

First we talked about going East, etc., then we talked about distances and going a long distance and a short distance and we talked about going home, coming to school. When we walk, or ride we go towards something that is East or West or North or South. We travel a distance in a direction. When we go from the door to the window we go, i.e., East. Are there other ways of going to the window? There are many ways of going different places when we know where they are. (demonstrate on sandbox, floor). If we know where we are and where the place where we want to go is, we can find many different ways of going there. If we know that a place is East we can go there, as long as we walk in that direction. But some ways are longer, others shorter. We can go to the window by going around the room till we find the window, or we can just walk across the room from the door to the window. (demonstrate with string). Sometimes we can remember where things are and sometimes we forget. Sometimes we can remember where things are by thinking of what they are near to, or by thinking of other things we find on the way. (Demonstrate). Sometimes we can go places by walking in the same direction of other people, following the noise they make, or towards the noise of cars. Objects, buildings, noises can all help to guide us towards a place. They tell us in what direction to go, and also how far we are. (Demonstrate with sounds). Building city in sandbox demonstrate different ways of going places. Have children represent different cities or buildings and others walk to them, roll balls, etc. Use cardinal points as locations. Build park with walks, benches, trees and people, progressively structuring whole space and parts.

8. *Location:*

Where we are: outside, inside, middle of the room, corner. Identification of place in relation to self. Here and there as definite location: in 1. here and there were used as directions. This material has mostly been covered but should be reviewed carefully at this point to separate the concept of location from that of movement. It is important that the children should have clear the idea that a location is different from a position, it refers to a determinate place, not a way of being, the way position does. Discussion and demonstrations aimed at clarifying doubts and misconceptions. Age of group and individual differences make too much difference for any specific description of procedure.

9. *Position:*

The relationship between parts, and between wholes. When we move the position of our body changes: we put one foot in front of the other when we walk, we put our hands behind our back, above our heads. We swing arms and legs, rock our body. We stand up, sit down, fall down, roll over, stoop, bend, we can even stand on our heads (demonstrate) but everytime we do something we change our position. We can change our position fast or slowly, very fast, or very slowly. We can remain in the same place and change our position: we can stand here or sit down here, or we can also move from one place to another. We can go from one room to another and that is changing our position, or we can go under the table and stand on the table and we have changed our position. When we go to another room we change our position because we change place, when we stay here and sit down or lay down we are in the same place and we have changed only the position of our body, everything else is still the same, all the things around us are the same and we still know where they are. We can paint a room and the room remains the same, just as big as it was before. We can set a clock at a different time and the clock remains in the same place and we still know where it is. We can take a drawer out of a bureau, and the bureau remains in the same place. When we open or close a window the window does not move, only part of it does, but we know where it is and can always find it. Let us find out what happens to the other things when we move, because even if we know that they are still there they seem to be different, and sometimes we get lost in our home. Let us start from a table. We all know this table; how tall it is, how large, smooth, etc. We are sitting at this table and the table is in front of us. Now we are going to sit under the table and see what the table is like from underneath. (do and have children examine table). It is quite different. The top of the table that was in front of us before and felt smooth, now is above our heads, it is like the ceiling. The top of the table is above us and we are underneath the table. To touch the legs of the table before, we had to reach down, now they are beside us. We are between the legs of the table. If we try to stand up we find that the table is too low for that and that our heads hit the ceiling. The table now is different and we would have a lot of trouble to recognize it as the same table we were sitting at before. The same thing happens sometimes when we move and find things from a different direction. Things have many sides and we know them well only if we know all sides. How does it feel to be under the table? It is like a tiny room, there is just enough room for us. Now let us see what it feels like to be upstairs, on top of the table. Let's do that one at a time: One child on table Feet of A. are on the table, they are just above our heads. The table is like the floor for A. The table is the ceiling for us. The ceiling of a room is the floor of another room. The ceiling of the room underneath is the floor of the room above. Did you ever tap on the ceiling with a stick? (demonstrate). If we tap on the ceiling of our little room, A. feels the taps under his feet. If A. taps on the top of the table we feel it just above our heads. (Demonstrate). A. is higher than all of us because he is upstairs. He is high up on the table and his head is way up. The bedrooms upstairs are higher than this room. (Demonstrate how much higher by going outside and having one child

call from window downstairs and another from window upstairs. Have children drop lines from window.)

Vocabulary:

above	on the top
up	below
low	high
underneath	bottom
down	

10. *Position:*

Table closed in with cloth. If we go under the table now this is really like being in a room, the cloth is the wall, the legs are at the corner. To go in we need to make a door. (Discuss position of door. Cut out door, get under table. Proceed the same way for window pointing to relative position of window, height of window from the floor and distance from the ceiling. Now we are under the table but also inside a room. Our room is as large as the table. Does it feel as large? Demonstrate). We now make another room with another table. What happens when we push the two rooms together? There is a wall between them and we cannot go from one to the other. Discuss possibilities: getting out of one and into the other or cutting door through.) We will cut a door between the two rooms so we can go from one to the other. Split group under tables. What happens to our windows? Are they on the same side? Let us look at our two rooms from outside. (Point to position of doors, windows, to the way rooms appear from the outside, have child inside at windows. Let children guess in what room he is from his voice, or other sounds.) And what about the ceiling of our rooms? We said that the ceiling of our first room was the floor for another room, what about the ceiling of the second room? Could we have two rooms upstairs? Is there as much room upstairs as we have downstairs? Could we make one room upstairs or two? How many walls do we need then? (Do it).

11. *Position:*

Third room downstairs: Position of door, window. Leave second room as corner room. Point out difficulty of going from first to third room without going outside. Build corridor, open doors on corridor. Outside looking at doors and windows is as in 10. Child on top of first table, second, third, children at windows. Make clear all possible relationships of upstairs and downstairs, rooms on one side of the house and rooms on other side. Repeat whole procedure with children outside of building and other children calling from windows. Repeat with children upstairs and children downstairs in the building. Play games with children representing rooms, holding hands for connected rooms. Investigate distance between floor and ceiling in actual room. Reproduce house with blocks, boxes, chairs, etc. Reproduce process with pegs in place of legs of chair. Repeat with folding paper, and emphasize position of walls relative to floors. Let children assume position, laying down on floor and being pulled up.

12. *The organization of other objects:*
Discuss, experiment with other objects that have sides, top and bottom, empty or full. Orient objects to cardinal points, to other objects, to surface of table, floor, ceiling.

FOLLOWING ARE SAMPLE LESSON PLANS:

PHASE I

Location: Indoors.

Equipment: 2 large sheets brown paper, 5 different little toys, masking tape, crayon.

Major objective: acquaint children with room, by establishing one point of reference.

Preparation: Place brown paper on wall opposite door. Place the toys around the room.

Minor objective: standing "tall"

Activities	Specific Objectives	Procedure
Hunt for a surprise	To provide warm-up activity. To give opportunity to explore room. To observe behavior.	"How many of you have gone on a Peanut Hunt?" — If you like to go hunting around, you will find a surprise. You may go anywhere in this room." Inform child when nearing objective.
Identify toys		
Measuring height	Locating wall. Lining up along wall. Establish position re: wall, other children.	Children stand in line facing wall. See what is on this wall? Who can guess what this paper is for? — We are going to see how tall you are. But first we must put your name on the paper, to show where you are standing so you can find your place again. I have a car, dog, etc., just like the ones you found. You all remember what you have. Let us stick them on the paper. Here is some tape for you, (place at shoulder height.) Let's make sure we can all find our marker on the wall and we all remember what it is. Who is the tallest? (Measure making heavy marks with crayon.)
Pinning names		

Summary	Repetition	Before we go away let us make sure we can come back to the same place tomorrow. Let's see if we can all find our marker. (Help children) and let's make sure we remember who is next to us. Ask children to name others in order. Point out: first, middle, last. And now let's see who is the first one to run to the door.
Location: room		
Equipment: none		Major Objective: orientation to the wall and to floor.
Preparation: none		Minor Objective: awareness of change in body position.
ACTIVITIES	SPECIFIC OBJECTIVES	PROCEDURE
Finding own place (review)	To provide repetition to encourage free movement.	From door: Let's run to the wall and find our markers. Encourage and praise running. Now let's run back to the door—Here (from door) where I am standing. Run as fast as you can. Repeat to wall.
Rolling on floor	To point out change in position. Tall and long: when we lie down we occupy space. Distance from head to wall. Whole body movements.	(Chin facing wall) Now let us all lie down on the floor to rest, right here where we are. Let's try to keep our feet just where they are. — Can you touch the wall with your feet? (take shoes off) Good, now see how well you can stretch? Keep your feet on the wall. Stretch — as long as you can like you do when you reach for something. Now your head is far away from the wall. How far is it? All rested? Then let's see if we can roll on the floor. (Call first child) You are the first, you must start rolling first. Roll and roll to the other wall and we will all come after you. (Help). Now let's stand up and this time we stretch

		way up as tall as we can — way up on tip toes. And who will be first to the door today?
Location: room		
Equipment: none		Major Objective: enlarging space of movement.
Preparation: none		Minor Objective: awareness of change of position.
ACTIVITIES	SPECIFIC OBJECTIVES	PROCEDURES
Rolling (review)	Repetition Whole body movements Provide choice	Who remembers what we did yesterday? Would you like to do it again? Roll and roll like your crayons do when they fall off your desk. Roll and roll like a ball.
Imitating animals	Provide more creative experience. Variety of body attitudes and movements. Relate activity to other experience.	Let's play a new game: I am going to make believe that I am an animal you all know. You come over and see what I do. You can ask two questions. If you can guess what I am you whisper it to me. (imitate dog or cat lying down). Now it is my turn to guess. (let each child have turn) Teach dog run, giraffe walk, or any other.
Marching		Make believe you are little babies — how do they walk? and now let's make believe we are soldiers and stand up real straight and stiff and tall. Let us stand in a row one behind the other, stiff and tall. Did you ever hear soldiers march? What do they sound like? Think you can sound the same way? They walk all at the same time — let's do it. Let's swing our arms while we walk. (Show). Does it feel the same as the dog run? Do you swing your arms when you walk? Some people do. They swing their arms back and forth, back and forth, the way the swing goes when you swing.

Location: playground

Major Objective: enlarging space of movement.

Minor Objective: muscular control.

Activities	Specific Objectives	Procedures
Walking	Practicing walking on uneven ground. Notice difference between pavement and ground: resistance, noise, smoothness. Directions: away from building, towards building. Distance.	Yesterday we walked and ran inside. Today we are going to take a walk outside. We will walk on the grass and we will walk on the street. I want you to pay attention and tell me when it feels different. (Walk away from building) Who can tell me where we are now. How can you tell? How does the ground feel when you walk? Can we walk on all fours? Is it easier here?
Chasing game	Large muscle activity.	Let's play: who knows a game? I'll run, let's see you catch me. (take turns) Maintain vocal contact. Let's run all together, let's all run back the way we came.
Running		Back at the bldg.: was it far? How far did we go today? Was it as far as from the classroom to the dining room? Let's go back, and see how far it is.
Walking		Let's walk all together the way we walk inside without running, and without stopping on the way. (go to same place — discuss) then walk back pointing out direction. Now let us go in. Tomorrow we will meet inside and you are going to find a surprise.

Lesson:_____

Location: Room

Major Objective: Correction of Veer

Equipment: Strips of paper, the length of the room, in four widths, from 2 feet to 4 inches.

Minor Objective: awareness of movement and posture in walking

Activities	Specific Objectives	Procedure
Making a path from one side to the opposite side of the room (review) using lengths of paper	Meaning of length, opposite sides, distance — distinguish length from width	Ask children to stand with back to West wall of room, point to opposite side, walk to it, lay out paper on floor, using lengths end to end. Two children working together, others checking.
Walking barefooted on paper path	Meaning of veer — walking straight ahead, across the room — as far as the other wall	Have children take off shoes and socks—walk, one by one, from West to East wall staying on path. Present as game to young ones, explain purpose to older groups. Keep error score: foot on floor.
	Correct posture, articulation of foot.	Note and correct: position of foot and leg, deviation in direction. Practice till all children can stay on largest path — then shift to next smaller width.
	For each child: keeps notes of direction of veer for consistency and of amount of veer.	Give individual explanations at level needed.
Running on path	Check and point out difference made by rate of walking, rhythm	Repeat with narrower strips till needed. Have children run on path—maintain direction by vocal contact.

Note: Repeat activities till children are able to maintain direction, and are aware of directional changes: emphasize that it is up to them to count deviations. Follow up with: id activities without path but definite reference (arrival) till awareness of extent of veer and at least correct directionality. Repeat outdoors — then check children walking alone, coming and going.

Lesson:_____

Location: Outdoors

Major Objectives: Sounds: follow, identifying source, resonance and echo: what they mean.

Equipment: Ball, two different bells.

Minor Objectives: attention to sounds

Activities	Specific Objectives	Procedure
Listening and describing sounds on street near building	Identification, description	Sounds help us in finding our way around and they can tell us where we are when we are lost. Discuss. Let's listen. . . . What can hear? Where does it come from? point. What makes it? What kind of a sound is it?
Walking towards sounds	Making specific source of sound and its localization	Select appropriate sound: e.g. motor of car, voices. Ask child who described it to guide us there. Repeat.
Making sounds Clapping hands	detect presence of bldgs., trees	Have children occasionally clap hands while walking, along building, on open ground: till diff. is noticed.
Walking and making sounds	Indications of distance	Then repeat walking towards building and away. Explain difference, have children explain: resonance. Differentiate from echo: use porch, walking towards and underneath porch. Only one clap hands.
Following sounds	direction	Only source of sound moves other children stand in same place. Children follow teacher's voice, steps, hand claps, bell.
Roll ball, wooden, on cement floor	Remembering and integrating sounds and variations in time	Children line up at one side of skating ring, T. rolls ball, varying direct. Listen, point to ball, by pointing follow course of ball — retrieve it.

Note: Play as games and give explanations as understanding develops and practice becomes automatic.

Note: Give special attention to children with difficulty in localizing sounds. It is important that also very young ones be explained — they can correct their error.

THE SPATIAL RELATIONS PERFORMANCE TEST

The test was developed in the course of a longitudinal study of the development of spatial perception in congenitally blind children, with and without light perception. The main purpose of the test was that of creating an opportunity for specific observation of performance at various age levels to obtain comparable data in terms of individual development and group averages. During the course of three years it was administered to a total of 132 children between 5 and 15 years of age. Approximately 100 of this total group were tested between two and four times. The source of many of the items included may be easily found in tests in common use in educational and clinical psychology, however, no attempt was made to duplicate testing situations or adapt scoring standards or criteria from other tests as it was not the purpose of this study to compare the performance of the blind with that of other groups of subjects.

A complete discussion of the test is beyond the scope of this report, however the following brief description provides an overview of the tasks included.

1. OBJECT RECOGNITION. The materials consisted of doll house furniture in 3 groups — 8 tables, 9 chairs, and 7 pieces of other furniture — 2 chests, a bed, crib, refrigerator, stove, and sink.

Aiming at testing recognition doll-house size replicas of furniture were selected on the assumption that they would be familiar to all children since it was known that this particular group of children had been exposed to these toys. This assumption proved unwarranted. The eight tables and nine chairs included varied in shape, size, material and texture, to establish whether the child had or formed a concept, or was naming the objects at random. The remaining seven objects, each different, presented various degrees of perceptual complexity and more specifically aimed at testing the child's ability to investigate the object, analyze details and synthetize them into meaningful wholes. Approximately 12 percent of the children in the present study recognized all the objects, while 20 per cent recognized none. In general younger children regarded them as toys, older ones as models, but in both instances correct naming of some of the items did not indicate a concept. The value of this item is to be found in the number and type of observations it makes possible with regard to tactual activity and perceptual processes.

2. CARS. The materials were Dinky toys: a truck, a jeep, and a sedan, scaled.

This item was designed to test discrimination of size and shape and concept of relative position, to observe freedom and extent of movement and the ways in which the child structures space spontaneously in a "play" situation. Identification of relative position depends on the ability to objectify the situation, i.e. to detach oneself from it and accept an objective frame of reference. This occurs twice in "cars": the first time when the child is asked to recognize the front and back of the cars, and relate this to direction of movement, and the second time when he is asked to identify the position of cars with reference to the road. In the second instance he is asked to imagine a situation which he has actually not directly experienced but which is basic to orientation. The child who calls "front" of the car the side towards him, moves the cars frontward, backwards and sideways and is unable to imagine the road situation. Correct understanding of the structure of the car in relation to direction of movement is a necessary, but not sufficient condition for correct answer to the "road" for this requires viewing movement and direction as other than the

experience the child has of it (motor and manipulative), and referred to a space of movement which if parallel to that of the child is nevertheless organized along vertical and horizontal axes other than those of the body.

3. SHAPES: A strip of mylar with drawing of: square, triangle, oval, circle, rectangle; wooden shapes: cube, cone, cylinder, pyramid.

Tests ability to recognize and name shapes, and to differentiate two-dimensional from three-dimensional objects. A separate score is given for differentiation of solids, regardless of correct naming as it was found that in many cases children had not been taught the names of solids (i.e., cube was called "square" or "square block"). In the vocabulary test the child is asked to define the same shapes and draw them, or select them: comparison of results of vocabulary and shapes is most interesting. It is relevant to note that sweeping grasping, and in some cases even static grasping touch, may differentiate squares, triangles and circles but metric touch is necessary to distinguish rectangles from squares and ovals from rounds when differences are relatively small, and both hands are needed for the identification of solids. Sweeping touch, in examining a square or a triangle may easily result in "something flat and round", and in reproducing a square in a series of round scribbles.

4. LOCALIZATION. The materials consisted of a hollow cylinder and two beads, one cylindrical and one spherical scaled to fit into the cylinder. The beads were inserted one at a time and the child asked which would come out first if the tuber were lifted.

This item owes its origin to Piaget and perhaps the type of explanations obtained would agree with his findings for a younger age. Blindness introduces a new variable that would have to be taken into account if results were to be compared: the blind child perceives the cylinder as having two holes, one at either end, rather than being hollow and on the first trial very often tries to retrieve the beads from the top. Failure on first trial and success on the second is a measure of learning that the hole goes through and applying this to the new situation represented by the turning of the cylinder. Failure on the second trial perhaps always indicates inability to localize the beads, regardless of results of first trial, unless the child himself understands and correctly explains the error. Such as it is, this item was of little value and was retained to establish whether or not localization in this sense and within these limitations appeared with greater frequency with increasing age and for the appeal the test has for the children, younger and older.

5. 2/3 DIMENSIONS: Materials included 5 containers of obviously different shape and size; 5 matching solids, and 5 two-dimensional shapes matching the solids. The child is presented all the materials and then asked to match the solid and container so that each container is "filled".

In the selection of the material, the idea was of giving the child a choice of an object that would fill the box and a lid that would cover the box. For this purpose the size and shape of containers and objects were obviously varied. Correct performance implied selection of correct shape and of the solids, and error derived from selection of correct shape and of the solids, and error derived from selection of wrong shape and/or selection of lid. It is doubtful, however, that this item is actually tapping discrimination of shapes and forms in all cases as certain of the children were very uncertain about the meaning of "full", although they never questioned it. When the E. became aware of

this difficulty and asked the child to explain what "full" means, obtained the answer: "It means that there is something in it".

6. SQUARES. Materials used were the halves, fourths, and eighths in the Fraction Square Game (No. 250 Arithmetic Tangibles). The child was provided an illustration of how the pieces could be combined to form a larger and different shape, e.g. two triangles combined to make a square. The child is asked to combine two, four, and eight pieces to form a square, and two, four, and eight pieces to form a triangle. Correct performance requires a geometric concept of shapes.

7. BLOCKS. The task involved is comparable to that of the preceding items except volumes are used rather than areas. The materials consisted of cubes and fractions of cubes to be combined to match a model presented to the child. Successful performance requires an integration along three dimensions rather than two.

8. BOARD. A rectangular wooden board (30x42 cms.) framed by a continuous raised rim 1 cm high and 1 cm wide. The surface of the board is covered by a rubber mat permitting impressions to be easily made in the Mylar sheet (plastic) which runs in a continuous roll across the rubber mat from one end to the other. In the center of one long side a window (1½" hole) is cut through the rim. On the other three sides of the rim a peg can be moved to various positions. The child is asked to draw a line across the Mylar from the peg to the window, starting with the peg opposite, then moving it to other positions. Then, with the peg opposite the window, the board is rotated 90 degrees (left or right depending on the handedness of the child) while the child is holding onto the sides of the board. He is then instructed to draw a line from peg to window without first feeling for the window. The task requires the perceptual abstraction and spatialization of a motor sequence.

9. STICKS AND DISKS. Task consists of two metal boards, the first 80x50 cms., the second 26x20 cms., 10 magnetized sticks in three lengths, and ten magnetized wooden disks each 4 cms. in diameter. The child is asked to duplicate designs and patterns involving the sticks and disks.

Correct reproduction of the stick designs implies the perception of the design as a whole: a specific set of spatial relationships. The size, the continuity of the design and the contiguity of the elements constituting it favor a synthetic prehension. Simultaneous sensory stimulation has structural meaning: the hand(s) that rest(s) on the design, if the size "fits" the hand, feels the whole at a glance, and exact reproduction of the relationships is possible not because each part has been learned but because the whole has been learned: the parts will be arranged so as to reproduce the whole.

10. SPATIAL VOCABULARY TEST: This test consists of 80 words subdivided in groups of 10 under the following headings: Dimensions, internal relationships, two and three-dimensional shapes, location, relationships of position, self reference, direction or position, static/dynamic space. The child is asked to explain verbally and to show what the words mean. He is invited to use the drawing board and any of the objects used in the test or that might be available. His verbal responses are tape recorded and at the same time responses are scored in terms of type: verbal, motor, or locomotor, a written account is kept of activity, in terms of type of definition and/or of description used.

Attack Score: Attack scores represent a summary of observations made on the method of attack of the specific tasks of the test and of the testing situation in general. In some cases additional observations were carried out to determine whether the attack during the test could be considered or not a typical method of the child. These observations included classroom situations and cottage or playground activity. The observation schedule on the following page was used as a guide. The results of these observations were compared with the annotations made on the performance of the various items of the test and summarized numerically under five categories: Relationships exploration, touch, perception and pressure, affording a score range of 0-18. Attack scores were interperted to mean efficiency of performance, actual or potential.

Reliability of Scores: The reliability of the Spatial Relations Performance Test and the Attack scores were computed on the basis of a test-retest at a five month interval. The reliability of the Performance Test Scores was .94, of the Attack scores .81. The reliability of the scoring procedure was checked by scoring and rescoring the initial Performance Test at a three-month interval. A reliability coefficient of scoring of .89 was obtained.

DATA GATHERED AND RESULTS

The following data were gathered with respect to each child in the experimental and control groups at two or more points in time as indicated below. The 1957 data were gathered as pre-test data in the fall of the year, while the 1958 and 1959 ones were gathered in late spring at the end of a phase of the training program. As reported earlier, the 1958 training program consisted of three half-hour sessions per week for a period of twelve weeks beginning in March 1958, whereas the 1958-59 training program continued throughout the school year at two hours per week.

	1957	1958	1959
Medical Report	x		x
Housemother Report	x		x
Self-care			
motor ability			
recreational			
Teacher Report	x		x
skill in Braille			
spatial orientation			
mannerisms			
activity			
Observer's Ratings		x	x
Orientation to sound			
obstacle perception			
motor control			
posture			
veer			
use of hands			
blindisms			
Spatial Relations			
Performance Test	x	x	x
Observations			
Performance			
Spacial Vocabulary Test	x	x	x
Chronological Age	x	x	x
Mental Age (interim Hayes-Binet)	x	x	x
Intelligence Quotient	x	x	x
Stanford Achievement Test (Adaptation for Blind) (grades 3-7 only)	x	x	x

Correlational analysis and t test for significance of differences in the means of experimental and control groups, as well as net differences between groups were made.

Table 1 provides a frequency distribution of chronological and mental ages of the control and experimental groups. The experimental group is somewhat younger and less able intellectually than the control group. In part this results from the greater homogeneity of mental age in the experimental group. The primary basis for selection was severity of handicap in the capacity to explore

the environment and attack new tasks. No special attempt was made to match groups other than to ascertain that they were roughly comparable, in the sense that gross disparity in age and tested intelligence was not present.

TABLE 1. CHRONOLOGICAL AND MENTAL AGES OF CONTROL AND EXPERIMENTAL GROUPS

Age Level	*Control Group*		*Experimental Group*	
	Chronological age	*Mental age*	*Chronological age*	*Mental age*
16.0-up		2		
15.0-15.9		3		1
14.0-14.9		2		1
13.0-13.9	3	1	2	
12.0-12.9	6	2	4	1
11.0-11.9	5	3	3	1
10.0-10.9	2	4	1	2
9.0-9.9	2	1	4	4
8.0-8.9	4	2	4	4
7.0-7.9	2	3	5	5
6.0-6.9	1	1	2	4
5.0-5.9	2	2	1	2
4.0-4.9		1		
N	27	27	26	26
Median	11.0	11.4	9.3	8.9

Subsequent Intelligence Tests routinely administered as part of the school testing program reveal equivalent growth in mental ages for both groups with mean Intelligence Quotients for the groups remaining nearly identical with that obtained in original test. Achievement test gains were comparable for both groups and were related to the elapsed period of schooling. No correlation was observed between gains on the Spatial Relations Performance Test and scholastic achievement.

Four sets of data were available for appraising the effectiveness of the training program designed to develop skill in ability to explore the environment and attack problems and the gains or changes in spatial orientation. Gains in exploratory skill in the control and experimental groups could be compared and these differences related to scores on the Spatial Relations Performance Test and to ratings by teacher, cottage housemother, and an observer. With the exception of the observer's ratings these data are shown in tables 2 and 3. The observer's ratings are not reported because none of the changes were statistically significant, in fact the changes noted were negligible. Observations were made of walking and running skills, maintenance of body position, orientation to sound, obstacle perception, posture, use of hands in grasping, reaching, holding, and of blindisims such as rocking, gyrating, jumping, swinging hands or arms. Three conditions affected the usefulness of these ratings and their reliability: The proximity of the two ratings (December-May), variation in location (shop, craft room, cottage, playground, gymnasium,

swimming pool) and the variability inherent in observations made in naturalistic setting. To expand on these difficulties: orientation to sound presents greater difficulties to blind children out-of-doors than inside, in a familiar setting, walking and running vary in relationship to the activity in which the child is engaged, blindisms occur with different frequency at different times and in relationship to the immediate activity and the degree of tension being experienced, and ratings on use of hands in grasping or holding will vary according to the object, e.g. basketball or pencil. In short, we learned that for such ratings to be useful as a minimum a child should be observed in the performance of comparable tasks rather than what chanced on a given day of observation and preferably some degree of standardiaztion of task is desirable.

The significant findings of the study are shown in Tables 2 and 3. The control group shows no changes of sufficient magnitude to be statistically significant with the exception of the teacher's rating for orientation (3.5) which is significant at the .01 level of confidence. The gain in attack scores (skill in approaching, exploring, and undertaking a manipulative task) approaches the .05 level of confidence. In comparison the experimental group shows changes which are statistically significant at the .001 level of confidence on four of the six measures (3.1, 3.2, 3.3, 3.5). The gains in attack indicate that the training program had positive effects, which is corroborated by the housemother's rating of performance. These effects had positive transfer effects on the experimental group's performance on the Spatial Relations Test and on their orientation in the classroom situation as judged by teachers' ratings. The net differences between the control and experimental groups are statistically significant on three of the four measures (3.1, 3.2, 3.5). A further corroboration of the findings is obtained when attack scores in both control and experimental groups are correlated with changes in performance scores on the Spatial Relations Performance Test. In both groups, separately and combined the relationship between gains is positive and statistically significant. The correlation coefficient approximates .65 in the combined groups.

It may be argued that in any comparison in which one group is trained and a second left untrained, changes in the experimental group are to be expected, and if they are statistically significant it is the result of comparing a program with no program, rather than two different kinds of programs designed to attain similar goals. In this study, both groups were participating in a well-planned and carefully conducted full time educational program for the blind. The time allocation for the special training program attempted in this study was a small fraction of the total educational experience of the child. In this context it is significant to demonstrate that the spatial perception of the blind, if it is to get beyond the motor-temporal to the conceptual stage, requires special training in environmental exploration and discrimination of relevant stimuli.

The negative argument in this study rests with the difficulties inherent in effecting the change and the limited degree of change. At the end of the study, the experimental group had yet to attain the original level of the control group in both attack and spatial scores. We suspect, judging from the scores obtained by some six year olds, that the critical stages for such training experiences may be in the pre-school years.

TABLE 2. PRE- AND POST-TEST SCORES OF CONTROL AND EXPERIMENTAL GROUPS.

Measure (range of scores possible)	Control						Experimental					
	Pre-Test			Post-Test			Pre-Test			Post-Test		
	Mean	S.D.	S.E.M	Mean	S.D.	S.E.M	Mean	S.D.	S.E.M	Mean	S.D.	S.E.M
2.1 Attack (0-18)	12.37	4.9	.9	14.3	4.8	.9	5.0	2.7	.5	9.8	4.5	.85
2.2 Spatial Relations Performance Test (0-60)	42.7	18.5	.4	46.7	17.2	.33	16.5	10.0	2.0	31.1	13.7	2.7
2.3 Housemother Performance (0-17)	10.9	5.0	1.2	13.1	3.8	.9	6.6	4.2	.9	10.9	4.9	1.0
2.4 Housemother Orientation (0-4)	3.4	1.1	.3	3.2	1.3	.3	2.2	1.5	.3	2.1	1.5	.3
2.5 Teacher Orientation (0-5)	4.0	1.1	.25	3.2	1.0	.23	2.4	1.3	.26	3.0	1.1	.23
2.6 Braille (0-5)	3.5	1.5	.4	3.4	1.2	.3	3.3	1.1	.27	2.9	1.0	.26

Table 3. Differences between Pre- and Post-Tests of Control and Experimental Groups and Net Difference between Groups.

Measure	Control				Experimental				Difference	
	Mean Diff.	*S.D.$_D$*	*S.E.$_D$*	*t*	*Mean Diff.*	*S.D.$_D$*	*S.E.$_D$*	*t*	*Mean Diff.*	*t*
3.1 Attack	1.9	4.2	.8	N.S.	4.7	3.0	.58	.001	2.8	.01
3.2 Spatial Relations Performance Test	4	10.2	2	N.S.	14.5	8.8	1.7	.001	4	.001
3.3 Housemother Performance	2.2	4.7	1.1	N.S.	4.3	4.5	.9	.001	2.2	N.S.
3.4 Housemother Orientation	.2			N.S.	.1			N.S.	.1	N.S.
3.5 Teacher Orientation	—.8	1.2	.26	.01	.7	.9	.2	.001	1.5	.001
3.6 Braille	—.1			N.S.	—.4			N.S.	—.3	N.S.